

50', with sun's altitude  $19^{\circ} 30'$ , bearing  $94^{\circ}$  E., observed a beautiful rainbow, concave, as usual, with apex at  $65^{\circ}$ , describing an arc of about  $50^{\circ}$ . In a few moments another bow made its appearance above the original one, of about the same size,

but convex, the limbs making a perfect contact. A moment or two later a lesser bow made its appearance, convex, with an altitude of  $40^{\circ}$ . Barometer 29.92; air temperature  $84^{\circ}$ ; wet bulb  $76^{\circ}$ ; sea  $84^{\circ}$ ; wind s. by e., force 3."

### VERIFICATIONS.

#### INDICATIONS FOR 24 HOURS IN ADVANCE.

The percentages of verifications of the twice daily indications for September, 1888, as determined from comparison of succeeding telegraphic reports, are given in the table below.

The predictions for districts east of the Rocky Mountains for September, 1888, were made by 1st Lieutenant H. H. C. Dunwoody, 4th Artillery, Acting Signal Officer and Assistant, and those for the Pacific Coast districts were made at San Francisco, Cal., by 2d Lieutenant J. E. Maxfield, Signal Corps; the verifications for all districts were determined by Assistant Professor C. F. Marvin.

*Percentages of indications verified, September, 1888.*

States.		States.	
Maine .....	83.3	Tennessee .....	90.6
New Hampshire .....	80.3	Kentucky .....	83.7
Vermont .....	80.3	Ohio .....	81.1
Massachusetts .....	80.5	West Virginia .....	78.7
Rhode Island .....	78.9	Indiana .....	83.3
Connecticut .....	76.1	Illinois .....	81.5
Eastern New York .....	81.5	Lower Michigan .....	82.1
Western New York .....	84.5	Upper Michigan .....	73.7
Eastern Pennsylvania .....	83.6	Wisconsin .....	81.3
Western Pennsylvania .....	80.5	Minnesota .....	82.0
New Jersey .....	81.1	Iowa .....	80.2
Delaware .....	80.1	Kansas .....	83.9
Maryland .....	77.6	Nebraska .....	83.9
District of Columbia .....	76.5	Missouri .....	78.2
Virginia .....	80.5	Colorado .....	87.1
North Carolina .....	85.9	Eastern Dakota .....	87.7
South Carolina .....	84.1	Southern California .....	84.4
Georgia .....	82.4	Northern California .....	85.3
Eastern Florida .....	85.1	Oregon .....	82.1
Western Florida .....	75.3	Washington Territory .....	82.6
Alabama .....	85.7	By elements: Weather .....	83.6
Mississippi .....	85.3	Temperature .....	79.4
Louisiana .....	79.9	Monthly percentage of weather and	
Texas .....	84.4	temperature combined .....	81.9
Arkansas .....	85.7		

#### CAUTIONARY SIGNALS FOR SEPTEMBER.

Statement showing percentage of justifications of wind

signals for the month of September, 1888: Number of cautionary signals ordered, forty-nine; justified, twenty-six. Number of storm signals ordered, twelve; justified, eight. Number of signals ordered for easterly winds, thirty-three; justified as to direction, thirty. Number of signals ordered for westerly winds, twenty-seven; justified as to direction, twenty-five. Number of signals ordered late, three. Number of storms without signals, thirty. Percentage of justifications, 55.1. No cold-wave signals were ordered during the month.

#### LOCAL VERIFICATIONS.

The following extracts from the published reports of the state weather services for September, 1888, show the percentages of verifications of weather and temperature signals:

*Indiana.*—Seymore: 78 per cent. of the indications were verified.

*Michigan.*—Weather signals are now displayed in one hundred and thirty-two towns, and upon the baggage-cars of twenty-six trains of eight of the principal railroads of the state.

The indications are issued at 10 p. m., daily, from the Chief Signal Office, Washington, and are for the twenty-four hours from 7 a. m. to 7 a. m.

The percentages of verifications of these indications for September are as follows (the verifications are taken from reports of displaymen furnished this office monthly): temperature, 81.4 per cent; weather, 79.4 per cent.; temperature and weather, 80.4 per cent.

Weather signals are displayed on the baggage-cars of the following railroads: C. & G. T. R'y; D. G. H. & M. R'y; D. D. G. T. R'y; M. C., main line and branches; C. & W. M. R'y; G. R. & I. R'y; P. H. & N. W. R'y; and the P. O. & P. A. R'y.

*Minnesota.*—The verifications of weather signals were 83 per cent. for weather and 82 per cent. for temperature.

*Nebraska.*—The percentages of correct weather predictions for the state were for temperature, 90.5; weather, 90.5; mean, 90.5.

*Ohio.*—The percentages of verification of weather signals received from Washington and distributed to thirty-two stations were seventy-nine for weather and eighty-seven for temperature.

*South Carolina.*—The percentages of verifications of weather and temperature predictions for the state were for weather, 85.0; temperature, 83.5.

### STATE WEATHER SERVICES.

The following extracts are republished from reports for September, 1888, of the directors of the various state weather services:

#### ALABAMA.

During the first week rains were continuous in most sections of the state; the last half of the month, however, was comparatively dry and favorable for gathering the cotton that has been opening rapidly, particularly in middle and southern Alabama. The rainfall for the month has not been large—the average being only 0.86 of an inch above the normal—but the unusual precipitation in August made the rain in September injurious to most crops.

The temperature was  $3^{\circ}.9$  below the normal, but no very decided cool spells occurred. The fall in temperature was gradual, with slight oscillations.

#### Summary.

*Temperature (in degrees Fahr.).*—Monthly mean,  $72.4$ ; highest monthly mean,  $75.7$ , at Fort Deposit; lowest monthly mean,  $65.7$ , at Gadsden; maximum,  $90.5$ , at Montgomery, 11th; minimum,  $35$ , at Gadsden, 30th; range for state,  $55.5$ ; greatest local monthly range,  $58$ , at Valley Head; least local monthly range,  $30$ , at Troy.

*Precipitation (in inches).*—Average for the state,  $4.89$ ; greatest,  $9.96$ , at Talladega; least,  $1.68$ , at Florence.

*Wind.*—Prevailing direction, northeast.—P. H. Mell, jr., Signal Corps, Auburn, director.

#### ARKANSAS.

*Temperature (in degrees Fahr.).*—Monthly mean,  $69.9$ ; highest monthly mean,  $77.6$ , at Malvern; lowest monthly mean,  $63.9$ , at Conway; maximum,  $97.0$ , at Lead Hill and Texarkana; minimum,  $40.0$ , at Heber, Graham, and Little Rock; range for state,  $57.0$ ; greatest local monthly range,  $57.0$ ; least local monthly range,  $22.0$ , at Dallas.

*Precipitation (in inches).*—Average for the state,  $1.01$ ; greatest,  $2.35$ , at Devall's Bluff; least,  $0.25$ , at Graham.—Prof. John C. Branner, Little Rock, director; W. U. Simons, Signal Corps, assistant.

#### ILLINOIS.

The temperature was equable, but lower than the average of corresponding months in previous years. There were no very cold, neither were there

any hot days. The warmest days were the 8th, 9th, and 10th, and the coldest the 28th and 29th; at no time did the temperature of the air fall below the freezing point, except in the extreme north on the 29th. There were several light frosts, and a killing one on the 29th, but no damage was done to vegetation.

The average temperature for the state was  $62^{\circ}.0$ , which was  $4^{\circ}.4$  below the average of the past ten years. Only once during that period, in 1879, has the monthly mean been lower, when it was  $61^{\circ}.7$ .

This deficiency of average temperature was evenly distributed over the state; in the northern and central divisions the deficiency was the same— $4^{\circ}.1$ , while in the southern it was  $4^{\circ}.8$ . The maximum temperature was about the average, but the minimum was lower than at any time during the past ten years.

The rainfall has, also, been much below the average of previous years. At only two stations—Peoria and Griggsville—was an excess reported. The monthly average was  $1.83$  inches below that of the past ten years, and was less than that of any September except in 1883, when it was  $1.21$  inches.—Col. Charles F. Mills, Springfield, director; James Cassidy, Signal Corps, assistant.

#### INDIANA.

Cool temperatures prevailed throughout the month, and the mean was nearly  $5^{\circ}$  below the normal. September, 1871, was as cool as the past month, and September, 1879, only was slightly cooler. The highest temperatures were noted at most stations on the 8th and 11th, and the lowest on the passage of the highest barometric area on the 29th and 30th; at many places heavy killing hoar-frost and ice formed on the mornings of these dates. Abrupt changes in temperature were of rare occurrence, the most noteworthy occurring on the 30th, with the rapid approach of a low barometric area during the latter part of the day, when the temperature rose rapidly, with a sudden fall in barometer.

The precipitation was small, except in the southeast portion of the state, where heavier rains occurred. During the first half of the month but little rain fell, and the number of rainy days was small. The least rain fell in the